Functional magnetic resonance imaging (fMRI) in human amygdala and bed nucleus of the stria terminalis (BNST) during processing of emotion at 7T.

Andrea Federspiel [1*], Matthias Grieder [1], Roland Wiest [2], Thomas Dierks [1] and Werner Strik [1]

[1] *Translational Research Center, University Hospital of Psychiatry and Psychotherapy, University of Bern, Switzerland*

[2] *Support Centre for Advanced Neuroimaging (SCAN), Institute for Diagnostic and Interventional Neuroradiology, Inselspital, Bern University Hospital, University of Bern, Bern, Switzerland*

Experimental procedure

Emotion-discrimination task and object-discrimination task as control condition was shown to activate the limbic system (i.e. amygdala) as well as the region of the BNST and is adapted from Sladky et al. (2018).
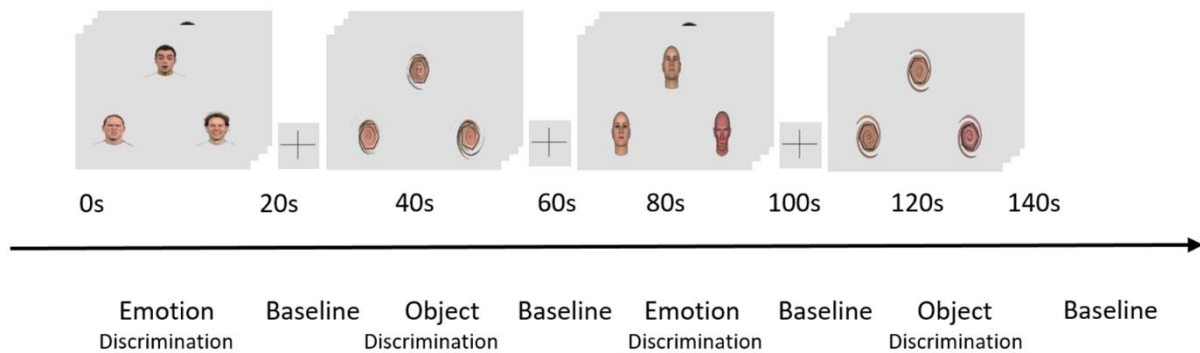

Figure 1. The experimental procedure: blocks of "emotion discrimination task", blocks of "baseline" and blocks of "object discrimination task". Each block will be 20 sec long.

The first pilot measurement was conducted at the MR Centre of Excellence, Medical University of Vienna within a 7T Siemens MAGNETOM (Siemens Medical, Erlangen, Germany). Two healthy volunteers were recorded while performing the fMRI task described above. The complete processing pipeline works successfully. In fact, the contrast face vs objects and the contrast faces vs rest revealed activation in the fusiform gyrus (FG), in bilateral amygdala (Amyg) and in the region proximal to the BNST (left panel of Figure 3 below). The signal characteristics within these regions of interest (ROI) showed significant % BOLD signal change associated to emotion discrimination task (right panel of Figure 3 below). The signal-to-noise ratio across all significant voxels in these ROI is 5.2 (FG), 3.71 (Amyg) and 2.17 (BNST) and clearly shows the presence of a signal associated with the processing of the emotion-discrimination task.
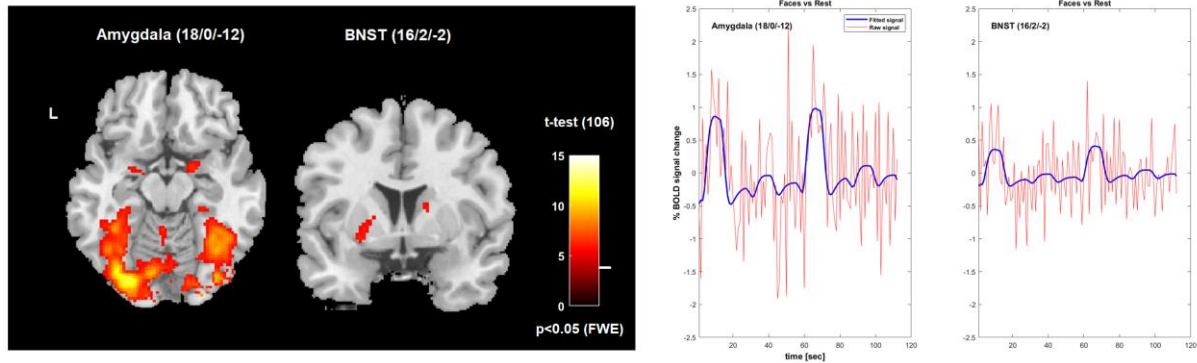
Figure 2. (left panel): activation of bilateral Amyg and bilateral fusiform gyrus of the Pilot study. (right panel): BOLD response extracted from Amyg and from region within BNST indicating clear increase due to processing of the "emotion discrimination task". The white bar at the t-test legend indicates the level of significance.

MRI acquisition

Anatomy (MP2RAGE) - The optimized acquisition parameters will be set as follows: 176 sagittal slices, 256 × 224 matrix (with a non-cubic field of view (FOV) of 256 × 224 mm^2, yielding a nominal isotropic resolution of 1 mm^3), 5000 ms repetition time (TR), 2.98 ms echo time (TE), 700 ms and 2500 ms inversion time (TI), flip angle 4° and 5°, GRAPPA acceleration factor 3 and a 8:22 min total acquisition time.

fMRI (Multiband-EPI) - The 72 EPI interleaved axial oblique slices will be positioned in-line with the bi-commissural axis with the following parameters: a multiband EPI sequence (CMRR). Slice thickness of 1 mm with 0.25 mm gap, in plane resolution 1.5×1.5 mm2. The following parameters will be set: repetition time TR=1.4 s, echo time TE=23 ms, flip angle 62°). In total, we will record 458 volumes lasting 10 min 40 sec.

B_0-map - The 72 EPI interleaved axial oblique slices will be positioned exactly as the fMRI slices with exactly the same slice geometry. Two amplitude and a phase image will be recorded in each subject (TR = 520 ms, TE1 = 4.92 ms, TE2 = 7.38 ms). The acquisition time will last 2 min 38 sec.